

THESIS FOR THE DEGREE OF LICENTIATE OF ENGINEERING

Public Sector Open Innovation

Exploring Barriers and How Intermediaries Can Mitigate Them

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Abstract

Public organizations are increasingly embracing open innovation (OI) practices. Still, little is known about how the challenges they face when doing so compare to the barriers that have been identified for OI in the private sector. Similarly, despite being recognized as imperative actors in private sector OI, the understanding of open innovation intermediaries' (OII) roles in public sector OI is limited. Given these two knowledge gaps, this licentiate thesis sets out to further the knowledge of what types of barriers impede public sector OI, and how OIIs can mitigate them. These issues are explored through four case studies within the public transport sector in Sweden. In all the cases, public organizations were trying to accelerate innovation through outbound OI practices, and in three of the cases, OIIs were utilized to facilitate the processes. A comparison of the case study findings and extant OI literature suggests that OI practices are harder to adopt for public organizations than for private firms. Public organizations face more rigorous regulations and more extensive bureaucracy, have fewer incentives to take risks, and are influenced by objectives and inner mechanisms that are difficult for external innovators to understand. Further, a cross-comparison of the case studies identifies that OIIs can mitigate the negative impacts of the aforementioned barriers by expanding the boundaries of innovation ecosystems, decreasing costs for distant search and data processing, fostering inter-organizational collaboration, and assisting public organizations in managing the innovation trajectory. Even so, the studied cases also illustrate that the introduction of OIIs can be contested, and that they might have hampering effects as well. Therefore, OIIs need to be carefully designed and launched so that they match the needs of the specific situations.

Keywords: Public Sector Open Innovation; Outbound Open Innovation; Open Innovation Intermediaries; Public Transport

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Appended papers

Paper A

Smith, G., & Sandberg, J. 2018.
Barriers to Innovation with Open Government Data:
Exploring Experiences Across Service Phases and User Types
Information Polity, 23(3), pp. 249–265. doi:10.3233/IP-170045

Smith planned the study and carried out the interviews. Led by Smith, Smith and Sandberg analyzed the data and wrote the paper.

Paper B

Smith, G., Ofe, H.A., & Sandberg, J. 2016.
Digital Service Innovation from Open Data:
Exploring the Value Proposition of an Open Data Marketplace
Proceedings of the 49th Hawaii International Conference on System Sciences (HICSS), pp. 1277-1286. doi:10.1109/HICSS.2016.162

Smith planned the study. Smith and Ofe collected the data. Led by Smith, Smith, Ofe and Sandberg carried out the analysis and wrote the paper.

Paper C

Smith, G., Hjalmarsson, A. & Burden, H. 2016.
Catalyzing Knowledge Transfer in Innovation Ecosystems through Contests
AMCIS 2016 Proceedings, available at: aisel.aisnet.org/amcis2016/Open/Presentations/2/

Led by Smith, Smith, Hjalmarsson and Burden planned the study, collected the data, performed the analysis and wrote the paper collectively.

Paper D

Smith, G., Sochor, J. & Karlsson I.C.M. 2018.
Public-Private Open Innovation:
Barriers in the Case of Mobility as a Service in West Sweden
Public Management Review, pre-press, pp. 1-22. doi:10.1080/14719037.2018.1462399

Smith planned the study, collected the data and performed the analysis, with support from Sochor and Karlsson. Smith wrote the paper with feedback from Sochor and Karlsson.

Paper E

Smith, G., Sochor, J. & Karlsson I.C.M. 2018.
Intermediary MaaS Integrators:
A Case Study on Hopes and Fears
Manuscript submitted to **Transportation Research Part A: Policy and Practice**

Smith planned the study, collected the data and performed the analysis, with support from Sochor and Karlsson. Smith wrote the paper with feedback from Sochor and Karlsson.

Nomenclature

TERM	MEANING
Application programming interface (API)	A set of definitions, protocols and tools for communication between distinct digital systems
External innovator	An external actor that contributes to the innovation processes of an innovation seeker, also referred to as a distributed complementor in OI literature
Innovation barrier	A factor that negatively influences the innovation process
Innovation ecosystem	A network of interconnected organizations, organized around a focal concept (i.e. an organization, a platform, a technology or a geographic region) that focus on the development of new value through innovation
Innovation seeker	An actor searching for external innovation through OI practices, also referred to as focal organization as well as OI initiator and OI organizer in OI literature
Mobility as a Service (MaaS)	An integrative concept that bundles different transport modalities into joint, seamless service offerings, as a means of providing tailored mobility solutions that cater for users' travel needs
Open government data (OGD)	Data, produced by public organizations, which is publicly available, and can be universally and readily accessed, used and redistributed free of charge
Open innovation (OI)	A distributed innovation process based on purposively managed knowledge flows across organizational boundaries of the innovation seeker, using pecuniary and non-pecuniary mechanisms in line with the innovation seeker's business model
Open innovation intermediary (OII)	An actor that intermediates between innovation seekers and external innovators in order to enhance the overall innovation capacity
Outbound open innovation	OI practices in which the primary direction of the knowledge flow is from innovation seekers to external innovators
Public sector	The part of the economy composed of both public services and public enterprises
Public sector open innovation	OI practices in which the innovation seeker stems from the public sector
Private sector	The part of the economy that is run by private individuals or groups
Request for information (RFI)	A business process, the purpose of which is to collect information from potential suppliers

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Introduction

During the second half of the 20th century, innovation scholars identified that innovative ideas frequently originate from outside the firm (e.g. Allen 1977). It was also recognized that complementary assets such as competitive manufacturing and distribution systems are vital for capitalizing on innovation (e.g. Teece 1986), and that business models that leverage openness and connectivity can provide access to such assets (e.g. Timmers 1998). These insights sparked an interest among innovation managers in augmenting traditional innovation practices by consciously insourcing external ideas and exploiting external paths to market (West et al. 2014). Chesbrough (2003; 2006) described this change as a paradigm shift from closed to open innovation (OI), and later defined the practice as a “distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization’s business model” (Chesbrough and Bogers 2014, p. 17).

Nowadays, OI practices are commonplace amongst private firms (Brunswick and Chesbrough 2018; Brunswick and Vanhaverbeke 2015; Chesbrough and Brunswick 2014), and empirical evidence suggests that it is a profitable strategy (Chesbrough 2017; Laursen and Salter 2006). In light of this large-scale adoption, a multitude of academic studies have reviewed OI in the private sector (cf. West and Bogers 2014). In a less researched field, public organizations have started to adopt such practices as well. As an example, Fuglesang (2008) argued that a pattern of OI is becoming more pertinent to service development in the public sector. Likewise, scholars have noted that several nations have launched explicit OI policies (e.g. Lee et al. 2012). However, many of the initiatives are arguably premature (Ham et al. 2015), suggesting that there might still be untapped potential for OI in the public sector. Additionally, the distinct institutional conditions for public organizations contra private firms (cf. Windrum and Koch 2008) infer that the transferability of extant OI knowledge to public sector OI is diminutive (cf. Chesbrough and Bogers 2014). For these reasons, and fueled by the need for public innovation in addressing grand societal challenges (Bekkers and Tummers 2018), public sector OI has been identified as an important avenue for future OI research (Vanhaverbeke et al. 2014). Further, given the current sustainability challenges in transport, as well as how on-going transformations such as urbanization and digitalization may disrupt the domain, transport has been pinpointed as a promising area for public sector OI (Kankanhalli et al. 2017). Accordingly, transport has also been identified as an appropriate empirical field for exploring how to foster such practices (ibid.).

At present, public transport (PT) accounts for roughly a quarter of the personal transport market in Sweden (Lindblom et al. 2016). In order to reduce the negative externalities of the transport system, key actors within the Swedish PT sector have agreed on a goal to double the market share by 2030 compared to 2006 levels (i.e. from 18% to 36%) (Grönlund 2017). However, despite the positive development thus far, analyses have shown that current PT strategies and budgets might be insufficient to reach this goal.

As a consequence, the PT sector is looking for new cost-efficient approaches to achieve market growth. One approach being explored is to give external actors access to internal assets so that they can develop and deploy services that in turn could increase the appeal of PT. This strategy can be conceptualized as outbound OI; that is, unlocking internal resources for external exploitation (cf. Gassmann and Enkel 2004). Moreover, in recent years, several types of actors have been introduced to facilitate such practices (e.g. Juell-Skielse et al. 2014; Söderman 2016). These actors can be understood as open innovation intermediaries (OIIIs); that is, actors that intermediate between the seekers and providers of innovation in order to enhance the overall innovation capacity (cf. Hallerstede 2013).

Against this backdrop, the objective of this thesis is to further the understanding of public sector OI, and what policy-makers and public managers can do to facilitate the adoption and use of such practices. More specifically, the thesis reports from four case studies within the Swedish PT sector to address two particular knowledge gaps regarding public sector OI.

First, to identify what types of barriers hinder OI efforts is a crucial step for developing policies, processes and tools that can effectively mitigate them. A burgeoning body of literature has studied barriers to private sector OI. Among other things, lack of inter-organizational trust (e.g. Westergren and Holmström 2012) and the ‘not invented here’ syndrome (cf. Katz and Allen 1982) have been recognized as major hurdles. In contrast, little is known about how the challenges public organizations face when adopting OI practices compare to the barriers that have been identified for OI in the private sector. Therefore, and based on the currently utilized OI strategies in the Swedish PT sector (outbound OI), this thesis addresses the following research question:

RQ1. *What types of barriers hinder outbound public sector OI?*

Second, the OII has been identified as an important enabler of OI (Hossain 2012; Katzy et al. 2013; Lopez-Vega and Vanhaverbeke 2009). In private sector OI, OIIs have been found to facilitate innovation processes by connecting innovation seekers and external innovators, and by providing collaborative functions as well as technological services (Lopez-Vega and Vanhaverbeke 2009). However, the roles of OIIs in public sector OI are poorly understood (Bakici et al. 2013; Gascó-Hernandez et al. 2017). To further the understanding of how OIIs can be designed and positioned to efficiently mitigate the adverse impacts of innovation barriers (and again based on the exploration of outbound OI practices by public actors in the Swedish PT sector), this thesis seeks the answer to the following research question:

RQ2. *How can OIIs mitigate barriers to outbound public sector OI?*

Frame of reference

Open innovation

Drawing on longitudinal case studies of the innovation strategies of high-technology firms, Chesbrough introduced the term OI in his 2003 book ‘Open innovation: The new imperative for creating and profiting from technology’. In essence, he argued that the underlying logic of the traditional (closed) innovation paradigm had been undermined by four erosion factors: the higher availability and mobility of skilled workers; the booming venture capital market; the growing need to reduce time to market; and the increasing capability of external suppliers (Chesbrough 2003). Facing these disruptions, he called for a new vision for corporate innovation strategy that “eagerly seeks external knowledge and ideas, even as it nurtures internal ones.... // ...utilizes valuable ideas from whatever source in advancing the company’s own business... // ...and places the company’s own ideas in other companies’ business” (Chesbrough 2003, p. xxxi). Since 2003, OI has triggered immense interest from both scholars and practitioners (cf. Chesbrough and Bogers 2014; West and Bogers 2014). Beyond the high-technology firms, OI practices have been adopted by other industries (Chesbrough and Crowther 2006; Gassmann et al. 2010), and the concept has progressed to nowadays encompass business model innovation and service innovation in contexts that include multiple collaborations, communities, and entire ecosystems (Chesbrough and Bogers 2014).

OI fundamentally means that innovation is generated by accessing, harnessing and absorbing flows of knowledge across organizational boundaries. On a fundamental level, this can be done through three distinct forms of OI: inbound, outbound and coupled (Gassmann and Enkel 2004). In the inbound form (also known as outside-in), the innovation seeker complements their internal knowledge base through the integration of external knowledge, with the purpose of increasing innovativeness (Enkel et al. 2009). Empirical studies have shown that this form of OI is the most commonly utilized in practice (e.g. Chiaroni et al. 2011). It is also the most researched (West and Bogers 2014). In contrast, the outbound form (also known as inside-out); that is, letting external organizations commercialize internal assets (Gassmann and Enkel 2004), is less explored both theoretically and practically. Still, outbound OI have been found to have non-monetary benefits (Kutvonen 2011) and positive effects on profitability, given suitable external conditions (e.g. high market turbulence) and proficient internal strategies (e.g. high R&D investments) (Hung and Chou 2013; Lichtenthaler 2009, 2015). This indicates that there may be latent potential benefits in outbound OI (Huizingh 2011; Lichtenthaler 2011). Lastly, coupled OI refers to joint development and commercialization of innovation (Gassmann and Enkel 2004). It can take many shapes, differing in the nature of the external partner, the coupling topology, the impetus for collaboration and the locus of innovation (Chesbrough and Bogers 2014). Thus, coupled OI can be interpreted as an umbrella term for enduring, bilateral innovation alliances.

Other dimensions can further inform the classification of OI strategies. Huizingh (2011) notes that both the process and/or the outcome of innovation can be either closed or open. Thus, he clarifies that the original case studies in OI research (e.g. Huston and Sakkab 2006) differ from concepts such as open access and open source in that the outcomes were not freely revealed in these cases (still, open access and open source also fit under the OI umbrella). Further, Dahlander and Gann (2010) distinguish between if the innovation seekers hunt direct benefits or indirect benefits, and denote these strategies pecuniary and non-pecuniary OI, respectively.

Public sector OI entails the OI practices in which the innovation seekers stem from the public sector (i.e. other actors can be public organizations, private firms, citizens etc.). Despite the historical lack of attentiveness to public sector OI, interest in it seems to be growing. In recent years, special issues of scientific journals (e.g. Bekkers and Tummers 2018; Kankanhalli et al. 2017), notable OI scholars (e.g. Cohen et al. 2016; Gascó 2017) and international OI conferences (e.g. the 4th World Open Innovation Conference) have concentrated on the public sector's roles in OI. At the same time, attention has arguably been placed on a subset of public sector OI, as the lion's share of extant studies on public sector OI has focused on inbound OI (cf. Kankanhalli et al. 2017). Moreover, much of this research stems from the e-government stream (cf. Yildiz 2007). Therefore, scholars have so far mainly studied OI cases where public actors strive to engage citizens in their innovation processes (e.g. Hilgers and Ihl 2010), with government transparency and citizen empowerment as central goals (cf. 'opening effects' in Schlagwein et al. 2017); in other words, the underpinning objectives have oftentimes leaned towards improving democracy. Few scholars have studied cases of public sector OI where the chief objective is to catalyze innovation throughput, despite this being the most emphasized potential advantage of adopting OI practices (cf. Chesbrough 2003, 2006). Equally, there is little knowledge about cases where public actors strive to increase their exploitation capacities by transferring internal innovations to external parties (i.e. outbound OI) or by creating enduring innovation alliances with complementary private sector partners (i.e. coupled OI).

In spite of the lack of focus from scholars on innovation-driven outbound public sector OI, emerging attempts to exploit the value of public assets through external innovators have been identified (e.g. Lee et al. 2012). Therefore, fueled by a call for studies targeting public sector OI (Kankanhalli et al. 2017; Vanhaverbeke et al. 2014) as well as by the emphasis on public-private collaboration within the emergent new public governance movement (cf. Osborne 2006), there is a need for more research on outbound and coupled OI initiatives in the public sector that are not used as proxies for other means (e.g. government transparency), but essentially aim at boosting innovation.

Barriers to open innovation

Barriers to innovation; that is, the factors that negatively influence the innovation process (Piatier 1984), is a frequent topic in innovation and management literature (e.g. Hadjimanolis 1999, 2003). Correspondingly, many studies have explored what type of barriers hamper OI adoption and OI outcomes. Drawing on the levels of analysis initially proposed by West et al. (2006), and increasingly embraced among OI scholars (e.g. Bogers et al. 2017), the main barrier types highlighted in extant literature can be summarized as illustrated in Table 1.

CATEGORY	DESCRIPTION	EXAMPLES OF BARRIERS
External	Barriers that originate from broader institutions such as the industry sector, society or innovation system	Frequent themes include legislation and policy, e.g. overcoming intellectual property (IP) rights (Savitskaya et al. 2010), and adhering to government policies and funding mechanisms (Lam et al. 2013)
Inter-organizational	Barriers that originate from the inter-organizational collaboration process	Frequent themes include partner relations and division of work, e.g. establishing trust (Westergren and Holmström 2012), and finding partners (Kutvonen 2011), dividing tasks (Van de Vrande et al. 2009), managing coordination costs (Laursen and Salter 2006)
Organizational	Barriers that originate from the innovation seeker's organization as a whole	Frequent themes include culture and organization, e.g. adopting external ideas (Laursen and Salter 2006), overcoming organizational inertia (Lüttgens et al. 2012), loosening protection of IP (Alexy et al. 2009), and risking increased complexity and loss of control (Enkel et al. 2009)
Intra-organizational	Barriers that originate from sub-levels of the organization, such as departments, teams, projects or individuals	Frequent themes include management and resources, e.g. internal management (Gassmann et al. 2010), sustaining commitment (Chesbrough and Crowther 2006), not using OI as a proxy to improve other measures (Golightly et al. 2012), and finding suitable manpower (S. Lee et al. 2010)

Table 1. Categorization of barriers to OI (adopted from paper D)

The majority of the studies referred to in Table 1 have taken place in private sector contexts. At the same time, innovation scholars have recognized that when it comes to innovation in general, public actors oftentimes face additional challenges compared to private actors (e.g. Albury 2005; Windrum and Koch 2008), which suggests that this also could be the case for OI. As a matter of fact, a recent OI study showed that external and inter-organizational as well as organizational barriers hinder public organizations from adopting OI practices (Mergel 2017). On a more detailed level, other scholars have proposed that formal rules, multi-layered hierarchies, organizational silos, divided political leadership and lack of incentives make it difficult for public actors to collaborate across their organizational borders, and thus to participate in OI (Sørensen and Torfing 2012). Additionally, public and private actors have been found to experience difficulties in collaborating on innovation topics since their objectives and interests, time horizons, risk behaviors, incentives for participation and expected rewards, as well as their innovation understandings are incompatible (Munksgaard et al. 2012). In particular, their inherent differences seem to make it challenging to establish inter-organizational trust and to develop well-suited management structures and innovation processes for such collaborations.

In summary, barriers on multiple institutional levels impede OI, which is thoroughly documented in extant OI literature. Furthermore, recent studies suggest that the ability of public actors to collaborate across their organizational borders is hampered by additional innovation barriers compared to private actors, and that the public-private divide hampers public sector OI even further. Nevertheless, these findings rest on limited empirical evidence, and supplementary studies are needed to validate and refine the propositions. This need motivates explorations of what types of barriers hinder public sector OI (i.e. RQ1).

The roles of open innovation intermediaries

Innovation intermediaries are actors that facilitate innovation, either directly by enabling the innovativeness of one or more firms, or indirectly by enhancing the innovative capacity of regions, nations, or sectors (Dalziel 2010). As a subset of these actors acting as catalysts for OI processes, OIIs have been defined as actors “that [use] OI platforms to bridge the gap between organizers that seek solutions to an innovation problem and innovators that can provide a solution to an organizer’s problem” (Hallerstede 2013, p. 35). The overall purpose of OIIs is to make innovation processes more efficient by lowering costs for all actors in the network (Secchi 2016).

OIIs can come in many forms. For example, Lopez-Vega and Vanhaverbeke (2009) outlined four main types: consultants that provide innovation services to solve specific innovation problems; traders that, based on a platform of innovation solvers, facilitate the identification of potential scientific- and business-oriented solutions; incubators that

provide infrastructures to facilitate internal knowledge exchange among firms searching to conduct science, technology or business activities; and mediators that provide infrastructures to facilitate the use of external ideas to conduct science, technology and business opportunities.

Howells (2006) detailed ten main functions for innovation intermediaries. Departing from his work, three overarching types of roles have been suggested (Lopez-Vega and Vanhaverbeke 2009). First, innovation intermediaries can connect innovation problems and solutions by building bridges, establishing networks and representing a single and neutral point of contact. Second, innovation intermediaries can foster inter-organizational collaboration by offering collaboration and support functions that compensate for the capabilities that the other actors are missing. Third, innovation intermediaries can provide technological services such as intellectual property advice, provision of pilot facilities, technology assessment, standard setting and regulation. Nonetheless, there are arguably major differences between OIIs and innovation intermediaries working under a traditional innovation paradigm. Specifically, OIIs are more dependent on informal relationships and high levels of inter-organizational trust (Porto Gómez et al. 2016). As a consequence, OIIs might have different roles compared to other innovation intermediaries.

Hossain (2012) emphasized that OIIs can contribute to companies by reducing costs for distant search; that is, facilitating innovation seekers' exploration of alternatives within technological trajectories or markets that are far away from the field in which they operate (Afuah and Tucci 2012). Other scholars have stressed OIIs' process management capabilities (Agogué et al. 2017; Katzy et al. 2013) as well as their ability to create a creative climate (Yström et al. 2015) and nurture sharing and absorption of knowledge (De Silva et al. 2018; Elmquist et al. 2016; Kokshagina et al. 2017). In essence, the roles of OIIs often go far beyond being a link between innovation seekers and solvers. They can rather be seen as an active actor that provides a wide range of the capabilities that are needed to successfully carry out innovation processes (Agogué et al. 2013; Aquilani et al. 2016).

In public sector settings, OIIs can be understood as actors that "intermediate between local/regional/national governments and other organizations and individuals with the purpose of enhancing public sector innovation capacity by means of applying OI methodologies: knowledge exchange, co-creation techniques and participatory methods" (Gascó-Hernandez et al. 2017, p. 143). However, the roles of OIIs in public sector OI have still received limited attention. In a notable exception, Bakici et al. (2013) analyzed how local governments in Finland, Germany, the Netherlands and Spain cooperate with OIIs. Among other things, they found that OIIs face unique objectives, methodologies and underlying problems in public settings due to the differences in the nature of innovation processes across public and private sectors. The authors also proposed that OIIs are necessary agents in public-driven innovation ecosystems that can maintain active

networks and facilitate innovation participation, bridge the perceived distance between organizations and orchestrate collaboration (ibid.). Other relevant studies have detailed how living labs (Gascó 2017) and online platforms (Mergel and Desouza 2013) may act as intermediary assets in public sector OI. Still, scholars argue that the documented knowledge is limited, and that the fundamental questions that need to be answered when implementing OIIs in public sector OI largely remain unanswered (Aquilani et al. 2016; Bakici et al. 2013; Gascó-Hernandez et al. 2017). Gasco-Hernandez et al. (2017) concluded that “more research is needed to understand this emerging phenomenon that links public and private sector organizations around innovation to generate value for citizens” (p. 146). Accordingly, and reiterated here, the second research question of this thesis addresses the lack of understanding for how OIIs can facilitate public actors’ outbound OI practices

Main takeaways

The reviewed literature indicates limitations in the knowledge of barriers to public sector OI, and of how OIIs can be utilized to mitigate them, thus motivating the two research questions addressed in this thesis. Furthermore, three main takeaways from the review of literature on private sector OI have been used as criteria for organizing the research on public sector OI reported in this thesis.

- » Outbound OI practices can improve firm performance in terms of both short-term and long-term profitability. Accordingly, it is important to consider both the direct and indirect influence of outbound OI on public sector organizations’ performance, i.e. the realization of their missions.
- » Private sector OI is hampered by barriers that arise due to internal and external factors as well as in the interaction with other actors. Thus, it seems vital to adopt a system perspective when exploring barriers to public sector OI.
- » In private sector OI, OIIs can provide benefits for innovation seekers as well as for external innovators. Hence, analyses of the roles of OIIs in public sector OI should encompass both perspectives.

Research approach

Methodology

Five fundamental methodological features informed the choice of research design. First, the research has primarily been driven by curiosity, interest and opportunity. The studied phenomenon was new to me and I was not guided by any clear conceptions of what I was looking for, at least initially. Therefore, I adopted an explorative approach (cf. Stebbins 2001). Especially, inspired by grounded theory (Charmaz 2006), I predominantly used open and flexible data collection techniques and bottom-up analyses of the collected data (cf. induction).

Second, the method of inquiry has primarily been qualitative, as I have been more interested in acquiring an understanding of public sector OI in a deeper sense, in contrast to matters such as its frequency of use or its impact on public actors' economic turnovers. For the same reasons, I adopted a multi-case study approach (cf. Yin 2018). This is considered an appropriate approach for exploring new phenomena in depth and for creating high-quality explanatory theories (Baxter and Jack 2008; Dyer and Wilkins 1991; Eisenhardt 1989). Still, in order to enhance transferability to other similar cases of public sector OI (cf. naturalistic generalizability in Myers 2000), I purposively sampled the cases to minimize differences between them (cf. Goggin 1986; Teune and Przeworski 1970).

Third, this thesis cannot be catalogued as traditional mixed methods research as I primarily relied on qualitative data. Nonetheless, I have utilized a triangulation approach (cf. e.g. Brannen 2005; Jick 1979) to data collection and analysis methods in order to create a rigorous documentation of as well as a holistic understanding of the studied phenomena (cf. pluralism).

Fourth, my research has in part been participatory. In particular I have been operatively involved in two of the cases (Cases 2 and 3), and work as a regional developer for Västra Götalandsregionen (the public transport authority, PTA, in West Sweden) in parallel to my Ph.D. studies. Admittedly, this implies some ethical risks (cf. Smith 2017), but even so, I am convinced that the fact that I participate in the system I study also leaves me in a better position to take ethically sound decisions in relation to my research project; basically because I am involved. Moreover, I might develop a better ability to predict and understand the consequences of my research, compared to if I solely observed.

Fifth, I have followed the footsteps of many precious OI scholars (e.g. Chesbrough et al. 2014; Rohrbeck et al. 2009; Schaffers et al. 2011; West and Wood 2008) by embracing an innovation ecosystem perspective (cf. Adner 2006; Adner and Kapoor 2010). Using biological ecosystems as an analogy, innovation ecosystems have been proposed to

model the economic dynamics of the relationships between actors whose functional goal is to either innovate or to enable innovation (Jackson 2011). Scholars have argued that the complex, dynamic and adaptive nature of ecosystems better describe contemporary innovation processes, compared to other analogies such as networks, clusters or systems (e.g. Gobble 2014; Mercan and Goktas 2011). As such, the ecosystem analogy seems particularly applicable when studying open and collaborative innovation processes. Further, I have used a socio-technical viewpoint (Trist 1981), meaning that I conceptualize innovation ecosystems as having a central focus on fulfilling societal functions, and thus encompassing both the development and diffusion of technology (Geels 2004).

Research design

The research was organized as an exploratory, qualitative-oriented, participatory multiple case study. Four distinct cases of public sector OI were studied which were judged as comparable along important dimensions (e.g. institutional settings) based on that they all were situated within the Swedish PT sector. Moreover, the cases exhibited distinctive characteristics that made them relevant for addressing RQ1. To begin with, all the four cases can be conceptualized as outbound public sector OI from the perspectives of the innovation seekers. In all cases, one or several public organizations were purposively adjusting their innovation strategies in order to boost the throughput of innovation, which they were hoping to capitalize on either directly or indirectly. Additionally, the strategy adjustments indicated that the public organizations were moving towards increasingly open and outbound innovation processes. Further, three of the four cases encompassed the introduction of OIIs. Thus, analyses of these cases can aptly inform a response to RQ2.

The cases were studied sequentially (see Figure 1). To retain the integrity of each case, data was collected and analyzed separately, prior to a final ‘case-based’ cross-case analysis (cf. Byrne 2009). The cross-case analysis followed a case-oriented methodology (cf. Khan and VanWynsberghe 2008) and was performed in a more holistic sense than commonly done in conventional reductionistic approaches to research synthesis (cf. Yin 2018). In other words, the analysis strived towards preserving the essence of each case and learning from their differences as well as from their similarities (Stake 2013). Therefore, patterns were first identified within each case. Then replications across the cases were searched for in relation to the respective research questions.

In the cross-case analysis process, the findings portrayed in the appended papers, as well as working material such as tentative propositions, codes and quotations, were reviewed to identify key similarities and differences across the cases. This analysis yielded common patterns regarding barriers (across all cases) and how OIIs were either perceived to have mitigated these barriers or anticipated to hold such potential (across three of the cases). Using the memo-writing technique (cf. Charmaz 2006), the identified patterns were

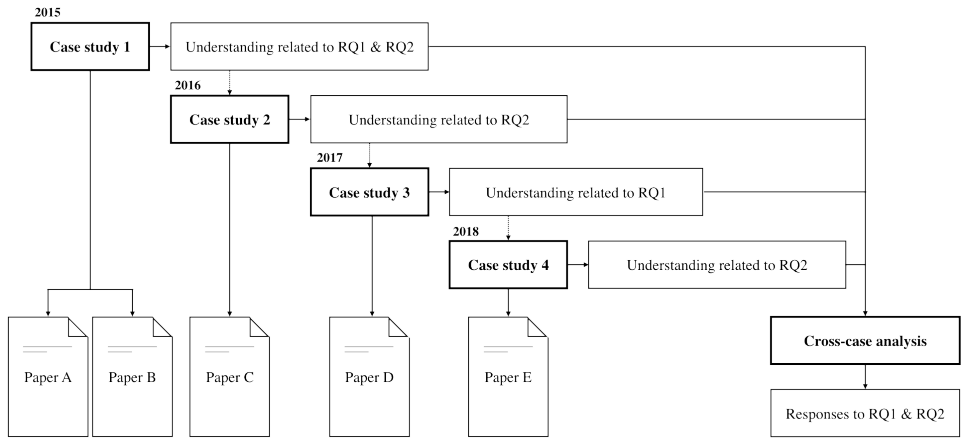


Figure 1. Research design

first summarized as tentative propositions. Then, following several iterations between the data and the tentative propositions, the OI literature was reviewed once again to compare the tentative propositions against existing theory and evidence. Ultimately, this helped position the propositions alongside existing knowledge and refine them into the findings and conclusions presented in the ‘analysis and discussion’ section.

Case studies

In the following, the four case studies are presented, including why they were conceptualized as cases of outbound public sector OI. A summary is offered in Table 2, including data collection methods (further described in the ‘summary of papers’ section).

Case 1, Trafiklab (approximately ‘traffic lab’), is the empirical basis for Paper A and Paper B. It is a community-type marketplace (conceptualized as an OII) that was launched in 2012 (trafiklab.se). The marketplace distributes open data from PTAs and the Swedish Transport Administration (i.e. innovation seekers) and is managed by their joint venture, Samtrafiken. Trafiklab aims to facilitate the external development of digital travel services of potential benefit to PT users (i.e. non-pecuniary outbound OI from the perspective of the data providers). At the point of data collection, more than 3000 members (i.e. external innovators) were affiliated with Trafiklab.

Case 2, EIC2015 (ElectriCity Innovation Challenge 2015), is the empirical basis for Paper C. It was a one-month innovation contest (conceptualized as an OII) that took

place in the autumn of 2015 (challenge.goteborgelectricity.se). The innovation contest was co-hosted by a consortium of 21 organizations within the PT industry (i.e. innovation seekers). Its central aim was to catalyze external innovation that could contribute to making contemporary electrified PT solutions more attractive to PT users (i.e. non-pecuniary outbound OI from the perspective of the contest consortium). The contest was built around the ‘ElectriCity Demonstration Arena’ (goteborgelectricity.se) and the ‘ElectriCity Innovation Platform’ (platform.goteborgelectricity.se). Three electric concept buses and seven pre-production models of plug-in hybrid buses form the core of the Demonstration Arena (2015 – 2018), which is meant to showcase how the efficiency, sustainability and attractiveness of tomorrow’s PT solutions can be increased. During the contest, public information about the Demonstration Arena and its components was provided through the Innovation Platform via a digital library and a novel application programming interface (API) that assembled real time information from buses and bus stops (Smith et al. 2016).

Case 3, MaaS RFI (Mobility as a Service request for information), is the empirical basis for Paper D. It was an attempt to procure Mobility as a Service (MaaS). MaaS has been described as an integrative concept that bundles different transport modalities into joint, seamless service offerings, as a means of providing tailored mobility solutions that cater for end-users’ travel needs (Mukhtar-Landgren et al. 2016). Hoping to boost PT usage, the PTA in West Sweden (i.e. the innovation seeker) decided to procure an external partner that could develop and deploy a MaaS solution that would include the regional PT offering (i.e. pecuniary outbound OI). In order to identify appropriate procurement terms, they initiated a request for information (RFI) process in which 30 potential bidders (i.e. external innovators) explicated their thoughts in individual meetings. In the end, the PTA determined that procurement was not the right path forward at that point in time (Smith et al. 2017).

Case 4, Mobilitetstorget (approximately ‘the mobility arena’), is the empirical basis for Paper E. It was an attempt to introduce an Intermediary MaaS Integrator (conceptualized as an OII) in Sweden. MaaS integration has been defined as the role of mediating the offerings from several transport service providers (and potentially other suppliers) to MaaS operators through activities such as technical integration, contract management and financial clearing (Smith et al. 2018). To facilitate the development and diffusion of MaaS in Sweden, Samtrafiken wanted to introduce a new intermediary actor that took this role. In order to prepare such an introduction, Samtrafiken performed two thorough development projects in which they collaborated with incumbent transport service providers (i.e. innovation seekers) and prospective MaaS operators (i.e. external innovators) on the MaaS topic. Nevertheless, following these projects Samtrafiken’s board of directors rejected funding the development of Mobilitetstorget, the reason being that its benefits were not deemed sufficient for motivating the required direct and indirect investments.

	CASE 1 TRAFIKLAB	CASE 2 EIC2015	CASE 3 MAAS RFI	CASE 4 MOBILITETSTORGET
OI purpose	Facilitate external development of digital travel services benefiting PT users	Catalyze external innovation that can make tomorrow's electric bus trips more attractive	Procure an externally operated MaaS solution for West Sweden	Facilitate the development of viable and sustainable MaaS solutions
OI strategy	Outbound, non-pecuniary	Outbound, non-pecuniary	Outbound, pecuniary	Outbound, pecuniary
Innovation seekers	Three PTAs and the Swedish Transport Administration collectively referred to as data providers	One PTA, one municipality and three private firms, collectively referred to as the contest consortium	One PTA	Multiple PTAs, municipalities and private firms, collectively referred to as transport service providers (TSPs)
External innovators	More than 3000 registered members	261 contest participants	One procured MaaS partner (selected from bidders)	Open to all external MaaS operators
OII type	An open data marketplace, managed by the jointly owned, third party, Samtrafiken	An innovation contest, managed by the contest consortium	-	An Intermediary MaaS Integrator, managed by the jointly owned, third party, Samtrafiken
Main data	Interviews with Trafiklab members (n=19)	Participatory observation before, during and after the contest	Interviews with the PTA and potential bidders (n=19)	Interviews with intended innovation seekers and MaaS operators (n=27)
Complementary data	Interviews with PTA representatives (n=6) and Samtrafiken personnel (n=9); an online questionnaire to members (n=84)	Online questionnaires distributed to contest participants and the contest consortium, (n=136); interviews with contest consortium members (n=7)	Participatory observation of the development of MaaS in Sweden 2016-2018	Questionnaire data (n=27); a review of related policy documents and political decisions

Table 2. Summary of cases and the collected data

Summary of papers

Paper A

Paper A – ‘Barriers to innovating with open government data: Exploring experiences across service phases and user types’ – was motivated by the limited understanding of external innovators’ struggles when developing services based on open government data (OGD) (cf. Verhulst and Young 2016). Time and time again, research on OGD innovation fails to consider the external innovators’ challenges in bringing their innovations to market (e.g. Janssen et al. 2012), and little is known about the links between the external innovators’ characteristics and their innovation capabilities (Safarov et al. 2017). Addressing these knowledge gaps, the paper set out to explore how innovation barriers affect the use of OGD in different phases of the innovation process, and how perceptions of innovation barriers vary across different types of external innovators.

Data for Paper A was collected through 19 semi-structured interviews, which were held with Trafiklab members (i.e. external innovators) that used or had used Trafiklab’s services. The interviews were guided by four topics: interviewee background information, motivations for developing services and for using Trafiklab, service development processes, and experiences of using Trafiklab and Trafiklab’s areas of improvement. The interviews were transcribed verbatim, and analyzed inductively following the recommended analysis procedure in Charmaz (2006).

Based on the inductive analysis, 38 distinct barriers were identified and subsequently cataloged into six interrelated barrier categories adopted from Janssen et al. (2012): institutional, task complexity, use and perception, legislation, information quality and technical. This exercise revealed that the barriers hindering the members from creating value are both social (e.g. lack of communication) and technical (e.g. poor data quality) in nature, and that only a subset of the barriers is directly related to Trafiklab’s provision of data. For instance, the members’ innovation efforts are also hindered by barriers related to collaborating with other partners and to marketing their services to end-users.

Next, the perceptions of the barriers were mapped against service lifecycle phases as categorized in the ITIL model. ITIL is a generic loop model (consisting of five phases – strategy, design, transition, operation and continual improvement), which has become the de facto standard in the software industry (Hochstein et al. 2005). This revealed that the members experience barriers throughout their innovation processes, but face different types of barriers in different phases. As an example, the lack of data, the impeding data format and the high task quality were perceived to be most challenging in the design phase, while the operation phase was impeded by lack of communication from data providers (innovation seekers), poor support, and slow and unreliable data provision.

The group of members was heterogeneous. The members differed in motivations, pre-conditions, approach and objectives. To illustrate this point, three archetypes were developed – employees, entrepreneurs and hobbyists – and the perceived barriers were mapped against these archetypes. In doing this, it was discovered that their experiences of barriers diverged. A summary of the archetypes’ characteristics and experiences of barriers is provided in Table 3.

	EMPLOYEES	ENTREPRENEURS	HOBBYISTS
Motivation	Primarily extrinsic	Extrinsic and intrinsic	Primarily intrinsic
Objective	Fulfill work tasks	Develop services to gain attention and/or earn money	Explore data, have fun and solve problems
Pre-condition	Service project is part of employment	Service project is part of entrepreneurial activities	Service project is part of leisure activities
Approach	Pursue clearly guided projects sequentially	Pursue industrial projects based on opportunities	Pursue several explorative projects simultaneously
Experience of barriers	High task complexity barriers during design and transition phases, and low use and participation barriers during all phases	High task complexity barriers during the transition phase, and high use and participation barriers during all phases	High information quality barriers and low technical barriers during the transition phase

Table 3. Proposed OGD user archetypes and their experiences of barriers (adopted from paper A)

In sum, Paper A addresses RQ1 by demonstrating that external innovators face an array of barriers when they participate in outbound public sector OI, and that the barriers impede all phases of their innovation processes. Further, the paper illustrates that the barriers are both social and technical in character, that the barriers stem from multiple sources across the innovation ecosystem, and that the external innovators’ characteristics influence their perceptions of the barriers.

Paper B

The starting point for Paper B – ‘Digital service innovation from open data: Exploring the value proposition of an open data marketplace’ – was the notion that merely providing access to OGD is not enough for facilitating external innovation (Janssen et al. 2012). In recent years, scholars have proposed that intermediary marketplaces can enhance

the effects of releasing OGD by facilitating interaction between OGD providers (i.e. innovation seekers) and OGD users (i.e. external innovators), and hereby increasing innovation activity (e.g. Janssen and Zuiderwijk 2014; Zuiderwijk et al. 2014). Still, few studies have surveyed by what mechanisms OGD marketplaces can do this. Thus, Paper B examined Case 1 and analyzed how Trafiklab's structures and practices create value for the Trafiklab members.

The previously described interviews with Trafiklab members also served as primary data for Paper B. Additionally, the analysis in Paper B covered complementary data on the characteristics of the Trafiklab members collected through an online questionnaire (n=84), six semi-structured interviews with data providers and nine semi-structured interviews with Samtrafiken personnel, as well as internal strategy documents from Samtrafiken.

As a first step in the analysis, the structures and practices of Trafiklab were outlined based on the interviews with data providers and Trafiklab personnel, supported by a review of the internal strategy documents. Four key elements were detailed: a technical platform that manages access to APIs and back-ends other digital services; a website that forms the digital front-end of the marketplace; support services for both data providers and members; and physical and digital knowledge-sharing activities, such as meet-ups and newsletters.

Then, five prominent values for external innovators were detailed based on the Trafiklab members' perceptions of the introduction of the aforementioned structures and practices. Trafiklab was perceived to lower the threshold for finding, understanding and using open PT data as well as for gaining access to appropriate support functions (lower task complexity). Trafiklab also increased the knowledge transfer to the members (higher access to knowledge) and provided an augmented channel for communicating needs to the data providers (increased possibilities to influence). Further, Trafiklab lowered the perceived risks involved with developing services based on OGD (lower risk). Finally, Trafiklab demonstrated that the data providers believed in OI, and it served as a showcase for further OI practices (higher visibility).

The five perceived values were compared with extant literature on barriers to OGD release and use (e.g. Barry and Bannister 2014; Janssen et al. 2012; Martin et al. 2013). The most notably positive impacts on barriers were lower task complexity and increased attractiveness of using OGD and actively participating in the OI ecosystem. However, the introduction of Trafiklab did not address all types of barriers and was perceived to have negative effects as well. For instance, the additional intermediary technical platform was perceived to affect information quality barriers negatively, which in turn could lower the potential innovation height and distress task complexity barriers. Adopting the categorization of barriers developed by Janssen et al. (2012), Trafiklab's impacts on barriers, as perceived by its members, are summarized in Table 4.

BARRIER TYPE	TRAFIKLAB'S IMPACT
Institutional	No impact
Task complexity	Positive impact
Use and participation	Positive and negative impact
Legislation	Positive impact
Information quality	Positive and negative impact
Technical	Positive impact

Table 4. Trafiklab’s impacts on innovation barriers (adopted from paper B)

In sum, Paper B contributes to the response to RQ2 by describing how external innovators perceive that the introduction of an OII can lower multiple barriers that they face when participating in outbound public sector OI. The paper also details how the studied OII’s elements contribute to its value proposition.

Paper C

Opening up innovation processes is associated with trade-offs, for example between the benefits of combining the efforts of a large and diverse pool of external innovators versus increased coordination costs (Greenstein 1993) and reduced ability to establish the innovation trajectory (Almirall and Casadesus-Masanell 2010). It also sparks a need for new tools for managing innovation that neither hamper generative capability, nor lower the attractiveness of participating in the innovation ecosystem. Drawing on this need, and based on the notion that sustainable ecosystem management relies on a diverse and multi-faceted knowledge system (e.g. Roux et al. 2006), Paper C – ‘Catalyzing knowledge transfer in innovation ecosystems through contests’ – set out to explore the knowledge transfer between the contest consortium (i.e. innovation seekers) and the contest participants (i.e. external innovators) in Case 2, as well as what consequences the contest had on innovation throughput and manageability.

The primary data collection technique was participatory observations of the activities of the contest consortium and the contest participants, which were conducted before, during and after the contest. This included observations of project meetings, discussions with funding agencies, contest events, interim reviews of the developed concepts, follow-up meetings with contest consortium members and contest participants, etc. In addition, three online questionnaires were distributed to the contest participants (the participants filled in the questionnaires in groups, n=50, 48, and 15, respectively) and one to the members in the contest consortium (n=23). Furthermore, data diversity was achieved by conducting seven semi-structured follow-up interviews with contest consortium members

and by reviewing data logs for how the contest participants used the Innovation Platform. The analysis was grounded in the observations and triangulated following a logic inspired by pattern matching (cf. Trochim 1985), meaning that propositions regarding the roles of EIC2015 were developed based on insights from the participatory observations and subsequently either rejected or not based on a review of the questionnaire data, the interviews and the data logs.

The analysis showed that the contest catalyzed a bidirectional transfer of both explicit and tacit knowledge, which ignited vast innovation-related activity during the contest. The overall positive jury assessment and the diversity among the contest submissions indicated that contests can be an appropriate tool for disseminating the envisioned innovation trajectory to contest participants without limiting their potential solution space or their interest in participating in the innovation ecosystem. Nevertheless, the analysis also showed that the spark lit by the contest did not generate sustained cross-border knowledge transfer. Six months after the contest, none of the generated prototypes were implemented (yet) and the processes to do so were either slow-moving or had halted. In addition, the relations between the contest consortium and the contest participants had rapidly dwindled.

In sum, Paper C tackles RQ2 by showing that an OII can benefit both innovation seekers and external innovators in outbound public sector OI by facilitating knowledge transfer. Further, it exemplifies that the design of the OII is reflected in its effects. In this case, the OII's impermanent design led to short-term effects.

Paper D

Paper D – ‘Public–private innovation: barriers in the case of mobility as a service in West Sweden’ – was motivated by the need for research targeting barriers to public sector OI. Further, to complement the perspective in Paper A, it focused on identifying what types of barriers that hamper innovation seekers in such practices.

Initial data was collected through participatory observation of the individual meetings between the PTA (i.e. the innovation seeker) and the potential bidders (i.e. external innovators). I, the first author, acted as an active participant (cf. Baker 2006) in all but four of the 28 meetings. A baseline for further data collection was developed through a review of my notes as well as of meeting minutes taken by an appointed meeting secretary. Just after the individual meetings, and prior to the PTA's decision to change path, 19 semi-structured interviews were conducted with purposefully selected representatives of the PTA and of the potential bidders. The interviews followed a flexible protocol with four conversation topics: experiences in relation to MaaS; visions and goals for the development of MaaS; perceptions of the on-going development and implementation process; and conditions for the emergence of sustainable and viable MaaS. Verbatim

transcriptions from the interviews served as the basis for the analysis, and were inductively analyzed following the guidelines proposed by Charmaz (2006).

Based on this analysis, 39 distinct barriers hindering the PTA were identified. By adopting an analytical framework for different levels of OI analyses (cf. Bogers et al. 2017; Chesbrough and Bogers 2014), it was illustrated that these barriers originated from external, inter-organizational, organizational and intra-organizational levels. Among other things, regulation and policy (external) was perceived to limit the action space of the PTA, which made collaboration with the potential bidders difficult (cf. Mukhtar-Landgren and Smith 2018). Collaboration was also hampered by the embedded differences between the PTA and the potential bidders (inter-organizational). Further, bureaucracy and political control (organizational), as well as lack of internal prioritization (intra-organizational), were perceived to impede the PTA's agility and speed in relation to innovation collaboration. Several barriers that primarily related to the concept of MaaS were also identified, such as lack of proven business models for MaaS.

Additionally, a comparison across the perspectives of the PTA and the potential bidders exposed distinctive differences in what types of barriers they emphasized, suggesting that each type of actor was more concerned with the barriers directly affecting their own work. For example, the PTA paid more attention to what the current legislation permits public organizations to do and the intricacy in setting up an appropriate governance scheme, whilst the potential bidders focused more on business and brand-related issues.

In sum, Paper D informs the response to RQ1 by illustrating that public organizations face multiple barriers when acting as innovation seekers in outbound public sector OI. Further, the paper shows that these barriers arise due to internal and external factors as well as in the interaction with external innovators. It also displays an inconsistency in how barriers are understood and emphasized across actors.

Paper E

Paper E – ‘Intermediary MaaS integrators: A case study on hopes and fears’ – was set against the vocal debates regarding MaaS in general (cf. Heikkilä 2014; Hietanen 2014), and the potential roles of intermediary MaaS integrators in facilitating its development in particular (cf. Smith et al. 2018); where intermediary MaaS integrators are actors that collect the offerings from transport service providers and distribute these to those operating MaaS (MaaS operators). Conceptualizing Mobilitetstorget (i.e. the OII in Case 4) as an intermediary MaaS integrator, the goals of paper E were to identify what dimensions define intermediary MaaS integrators, and to describe the hopes and fears that incumbent transport service providers and prospective MaaS operators have vis-à-vis them. Based on this knowledge, the paper also proposed implications for the design and use of such actors.

Shortly after Samtrafiken's board of director's decision to cancel the development of Mobilitetstorget, 27 semi-structured interviews were performed with a purposively selected sample of incumbent transport service providers (i.e. innovation seekers) and prospective MaaS operators (i.e. external innovators). A review of Samtrafiken's documentation informed a twofold interview protocol, which covered five questions regarding MaaS developments in general in its first phase and five questions regarding Mobilitetstorget in its second phase. Further, after each phase of the interviews, the interviewees were asked to react to a set of Likert-scale statements (Likert 1932) regarding MaaS (after the first phase) and Mobilitetstorget (after the second phase). The core of the analysis was an inductive and qualitative review of interview transcripts, while a non-parametric analysis of the responses to the statements was used to triangulate the findings on the potential roles of Mobilitetstorget.

Based on this analysis, three dimensions that influenced the perceptions of Mobilitetstorget and its potential impacts were identified: activities (the process-, business- and technical-facilitation undertakings), management (the characteristics of the management organization and its strategies) and processes (the processes for preparation, development, launch, operation and continual improvement). Drawing on the 5w1h framework (cf. Sæbø 2011; Yates and Orlikowski 2002), the paper proposed that these three dimensions, if complemented by a description of the institutional context, can inform a holistic understanding for intermediary MaaS integrators.

The analysis of hopes and fears showed that the proposed introduction of the intermediary MaaS integrator was contested amongst incumbent transport service providers and prospective MaaS operators, primarily due to the suggested technical activities. Some interviewees foresaw huge benefits, such as streamlined investments, facilitated collaboration, eased management of the trajectory for MaaS and instigated policy changes that could speed up development and diffusion. In contrast, others anticipated that the intermediary MaaS integrator would add unnecessary costs, impair commercial potential and inhibit service quality of MaaS, if introduced. A summary of the identified hopes and fears is provided in Table 5.

Finally, implications for the design and use of intermediary MaaS integrators were proposed based on the analyses of defining dimensions and hopes and fears of incumbent transport service providers and prospective MaaS operators. In short, it was suggested that intermediary MaaS integrators should: go beyond offering technical services; have clear and outspoken objectives; be impartial and capable actors; carefully consider their launch strategies; and only be introduced if basic incentives are in place for using them.

In sum, Paper E adds to the response to RQ2 by illustrating that the potential introduction of an OII elicits both hopes and fears among innovation seekers and external innovators in outbound public sector OI. Further, the paper identifies four dimensions that influence how the OII is perceived.

DIMENSION	HOPES	FEARS
Activities	Proposed activities instigate policy changes, manage the trajectory, lower entry barriers, facilitate collaboration, propel operative action and streamline investments	Proposed activities add unnecessary costs, impair commercial potential and inhibit service quality
Management	Samtrafiken efficiently coordinates a common MaaS agenda, guides towards transport policy objectives and caters for the needs of all TSPs and MaaS Operators	Samtrafiken is held back by the portion of their owners that have low incentives to pursue MaaS and Mobilitetstorget
Processes	The collaborative development process creates MaaS-related knowledge and disseminates it to TSPs and MaaS Operators as well as to policy makers	The hasty and narrow-minded development process leads to non-optimal and costly solutions for integration
Context	Key TSPs are ready to collaborate on MaaS as they have previously collaborated on technical standardization, open data and multi-modal travel planning	Viable MaaS services are difficult to develop due to a lack of transport services to integrate and due to small financial margins across the industry

Table 5. Hopes and fears vis-à-vis Mobilitetstorget (adopted from paper E)

Analysis and discussion

First, and foremost, this licentiate thesis adds four thoroughly analyzed cases of outbound public sector OI to the common pool of OI studies. As both outbound strategies and public sector applications of OIs have received (too) little attention thus far, this is an important contribution per se. However, the cross-case analyses of perceptions of barriers to public sector OI and of how OIIs can be utilized to mitigate them also bring valuable knowledge.

Barriers to public sector open innovation

The cross-case analysis of perceived barriers in Case 1 Trafiklab and Case 3 MaaS RFI provides an answer to RQ1 – ‘What types of barriers hinder outbound public sector OI?’ – by painting a picture of an array of barriers that hamper both innovation seekers and external innovators. A comparison to extant literature on OI barriers indicates that some of the identified barriers are either unique or augmented, compared to private sector OI. For instance, the innovation seeker in Case 3 was hampered by organizational inertia as well as by external regulations and policies such as the PT act, the local government act and the competition law that all favored sticking to traditional innovation practices. This type of legal challenge has not been mentioned in the reviewed literature on barriers to private sector OI (cf. the ‘barriers to OI’ section). In contrast, organizational inertia has indeed been highlighted as a barrier to private sector OI (e.g. Lüttgens et al. 2012) as well as to disruptive innovations in general (e.g. Sandberg and Aarikka-Stenroos 2014), but the political management, the heavy bureaucracy and the lack of innovation tradition on the part of the innovation seeker seemed to add extra hurdles. Furthermore, the external innovators in both Case 1 and Case 3 struggled with understanding the innovation seekers’ motives and actions, which was possibly due to the vast differences between how public and private sector actors are driven and organized. As such, the analysis supports previous notions on that the public–private dimension increases complexity (e.g. Br 2010; Munksgaard et al. 2012; Sørensen and Torfing 2011, 2012), and implies that further efforts might be needed to facilitate outbound public sector OI, compared to private sector OI.

The analysis of barriers also complements existent OI literature by emphasizing diversity in the types of barriers, their causes and how they are perceived. Five points can be made to illustrate the diversity, and to discuss what implications can be drawn from them in relation to outbound public sector OI.

First, the barriers that external innovators recognized did not only relate to the collaboration between innovation seekers and external innovators, but were also linked to interactions with other actors. For instance, the external innovators in Case 1 struggled with teaming up with partners and with communicating with end-users, and the innovation seeker in Case 3 had to place a lot of effort into coordinating with other public

actors in their domain. This finding emphasizes the importance of utilizing an innovation ecosystem perspective when analyzing opportunities and limitations for public sector OI (cf. Adner and Kapoor 2010).

Second, as exemplified in the first paragraph of this section, the added barriers (compared to private sector OI) originated from the external as well as the inter-organizational and organizational levels. Externally, regulations and policies that do not apply to private firms limited the action spaces and slowed the innovation processes of the public innovation seekers, making it difficult for them to collaborate with private actors. In the collaborations across organizations, the public-private divide also added intricacy to the tasks of establishing trust and to agree on innovation processes and goals (cf. Debackere et al. 2014; Munksgaard et al. 2012). On the organizational level, lack of incentives to prioritize innovation, as well as the added bureaucracy and political control that the public innovation seekers faced, fostered organizational inertia and risk aversion (cf. Sørensen and Torfing 2012). Thus, combined actions from international, national, regional and local public organizations might be needed to comprehensively improve the conditions for outbound public sector OI.

Third, the hampering effects of the identified barriers were significant throughout the innovation process, from initial idea to societal impact. This was especially revealed through the Case 1 analysis, which found that the external innovators were hampered by: lack of cooperation, communication and service license agreements with innovation seekers during the strategy phase; lack of data, impeding data formats and high task complexity during the strategy phase; lack of time to develop services, and difficulties in developing services with unique value propositions and in gaining end-users during the transition phase; lack of communication from innovation seekers, poor support, slow data provision and low back-end reliability during the operation phase; and lack of understanding of how the services could be improved and difficulties in motivating efforts to do so during the continual improvement phase. This notion underscores the significance of focusing on innovation diffusion as well as innovation development when designing interventions meant to boost outbound public sector OI.

Fourth, as seen in the example described in the previous paragraph, many of the perceived barriers in Case 1 were social rather than technical in nature. This was also evident in Case 3. For instance, the external innovators argued that both technical and contractual harmonization across the innovation seekers would be needed to enable their development of viable services. This finding enforces the view that just providing access to data is not enough for facilitating external innovation (Janssen et al. 2012). Instead, one must look beyond technical aspects when trying to create conditions for widespread and effective outbound public sector OI (cf. Gurstein 2011).

Fifth, the cross-case analysis illustrated distinctive differences in how the barriers were perceived across different types of external innovators (primarily in Case 1), as well as across the innovation seekers and the external innovators (primarily in Case 3). As discussed earlier, the latter divergence seems to be enhanced by the public-private sector divide. For example, the innovation seeker in Case 3 saw a potential trade-off between the creation of public values and the creation of business values, with which the external innovators did not agree. Since a shared conceptual space is key for collaborative problem-solving (Roschelle and Teasley 1995), this cross-actor discrepancy signifies the importance of establishing collaborative environments where actors can come together to devise shared understandings in order to facilitate outbound public sector OI (cf. Nambisan 2008; Osborne and Brown 2013).

Open innovation intermediaries' roles in public sector open innovation

The cross-case analysis of the roles of the OIIs in Case 1 Trafiklab, Case 2 EIC2015 and Case 4 Mobilitetstorget provides an answer to RQ2 – 'How can OIIs mitigate barriers to outbound public sector OI?'. The analysis demonstrates that OIIs can offer several values to innovation seekers and external innovators that in effect mitigate several of the barriers perceived as hampering outbound public sector OI. In this thesis, these perceived values are summarized in four interrelated roles that OIIs can take (cf. Smith and Akram 2017).

First, OIIs can expand the boundaries of innovation ecosystems by increasing the connectivity in the early phases of the innovation process. Three mechanisms contribute to this role. All three cases exemplify that the introduction of an OII can increase the awareness of an OI innovation ecosystem, and the possibility to participate in it among both potential innovation seekers and external innovators. For instance, the mere existence of the OII in Case 1 communicated the innovation seekers' interest in OI partnerships. Further, Case 2 illustrated that OIIs can be used to mobilize potential participators, and Case 4 showed that OIIs can lower the entry barriers that delimit participation such as investment costs and requirements on technical know-how.

To connect innovation seekers with a diverse set of skillful external innovators has been outlined as one of the main roles of OIIs in previous literature on private sector OI (e.g. Aquilani et al. 2016; Hossain 2012; Lopez-Vega and Vanhaverbeke 2009). This study highlights a specific part of this role (to expand the boundaries of the innovation ecosystems). Accordingly, it strengthens claims that OIIs can contribute to OI by bridging the gap between innovation seekers and external innovators as well as the gap between innovations' areas of application and useful knowledge domains (e.g. Lopez-Vega et al. 2016).

Second, OIIs can decrease costs for distant search and data processing by making it easier for external innovators to find, access, evaluate and compare data from multiple sources. Examples of measures that added to this perceived value in the studied cases were technical standardization and contract harmonization. Still, it was the provision of central access points for data that the external innovators regarded as the biggest contribution to their quests of acquiring knowledge from outside their native environment, and of putting the data to use. Although present in all three cases, this mechanism was particularly evident in Case 1. The OII's compilation and structured presentation of data from multiple innovation seekers was perceived by external innovators to make it less cumbersome to get an overview of available data and to identify the most appropriate data sets for their purposes. Furthermore, the introduction of the OII also meant that they were able to find more of the required resources for service development at one spot, such as documentation, operating status and tier one support.

Many scholars have previously discussed the capability of OIIs to enable, guide and streamline distant search for innovation seekers (e.g. Jeppesen and Lakhani 2010; Kokshagina et al. 2017). This proposed role extends this notion by stressing that OIIs can offer similar benefits to external innovators as well.

Third, OIIs can foster inter-organizational collaboration by uniting innovation seekers and external innovators, and by facilitating knowledge creation, sharing and absorption. In Case 1, the external innovators highlighted that the OII enhanced their access to the knowledge base of innovation seekers as well of other external innovators. It also provided them with an augmented channel for communicating with innovation seekers. Case 2 reiterated similar gains for the external innovators. It also showed that the OII increased the knowledge flow to the innovation seekers. Similarly, in Case 4, both innovation seekers and external innovators thought that the planned OII would increase inter-organizational interactions and thus enhance all actors' access to knowledge.

Beyond supporting earlier notions regarding the capability of OIIs to advance inter-organizational collaboration by brokering and cultivating knowledge (e.g. Bakici and Almirall 2017; De Silva et al. 2018; Howells 2006), this proposed role underscores that the increased knowledge exchange between the two groups also can enhance external innovators' opportunities to understand and influence the innovation seekers. In other words, OIIs can help empower the external innovators.

Fourth, OIIs can assist innovation seekers in managing the innovation trajectory. In Case 2, the OII ignited vast innovation activity among external innovators. The outcome of this activity was assessed as both diverse and fitting with the innovation agendas of the innovation seekers. Thus, the OII was deemed a suitable tool for disseminating a preferred innovation trajectory to external innovators without limiting their potential solution space or their interest in participating in the innovation ecosystem. Similarly, to manage the innovation trajectory was emphasized as one of the most significant

prospective contributions of the planned OII in Case 4. In particular, the proposed regulatory framework, the standard collaboration agreements and the implicit leadership role were identified as effective tools in this regard.

Scholars have previously discussed how OIIs can be used for managing OI development paths (e.g. Agogu   et al. 2013; Bakici et al. 2013; Felin and Zenger 2014). The studied cases add to these studies by illustrating that contracts as well as trust and power can be important governing mechanisms for public sector OI. Thus, this proposed role supports earlier notions that trust is an important asset for managing development in knowledge-based economies (Adler 2001; de Reuver and Bouwman 2012; Powell 2003).

The question is though: are the four identified roles particularly relevant for public sector OI? The public sector comprises many actors that do not currently engage in collaborative innovation activities due to innovation barriers such as low innovation incentives, risk averse cultures and poor change management skills (Mulgan and Albury 2003; S  rensen and Torfing 2012). As a consequence, the OIIs' role of increasing OI awareness among innovation seekers and lowering their entry barriers might be more fundamental in public sector OI, in comparison to private sector OI. Especially, OIIs might have the capability to address some of the legal and procedural barriers that public actors are experiencing in relation to outbound OI (Edler and Yeow 2016). Furthermore, the OIIs' role of brokering knowledge between innovation seekers and external innovators is arguably extra valuable when public and private actors are supposed to collaborate, as the cognitive distances between them are larger and since their perceptions of innovation barriers are incongruent. On a similar note, the OII's role of assisting the management of the innovation trajectory can also be seen as especially relevant in public sector OI. As the work of public actors is usually guided by policy goals rather than financial motives, public innovation seekers likely want to steer the OI trajectory towards objectives that business-driven external innovators may find more difficult to interpret and understand, compared to when innovation seekers and external innovators share similar motives (Munksgaard et al. 2012). In conclusion, all four identified roles seem to be particularly important in public sector OI, although applicable to private sector OI too.

Nevertheless, the case studies also indicate that the perceived value of OIIs as well as their effect on innovation throughput rest upon appropriately matching their characteristics with the needs of both the innovation seekers and the external innovators. For instance: the services of the OII in Case 1 were perceived differently across different types of external innovators; the knowledge exchange was discontinued in Case 2, why the OII only had a temporary effect on the innovation ecosystem; and the planned OII in Case 4 was in general highly contested. So, in order to facilitate throughput in terms of innovation, this thesis proposes that it is vital for public actors to thoroughly evaluate the contextual factors of the innovation ecosystem as well as the needs of its participants prior to designing and implementing OIIs. Moreover, a service lifecycle perspective should be utilized in order to ensure that the entire innovation process is catered for.

Concluding remarks

To this end, this thesis reports on four field-based case studies in the Swedish PT sector. The studies explored what types of barriers hinder outbound public sector OI, and how OIIs can be utilized to mitigate them. Returning to the three main takeaways from the frame of reference, the studies collectively consider both direct and indirect effects of outbound public sector OI, utilize an ecosystem perspective and analyze the perceptions of innovation seekers as well as external innovators.

The analysis on barriers found that a diverse set of barriers hinders outbound public sector OI. Adding to extant OI literature, the analysis suggested that the public-private dimension as well as the institutional conditions that public organizations operate under make it harder for them to adopt OI, compared to private firms. Public organizations face more rigorous regulations and more extensive bureaucracy, have fewer incentives to take risks, and are influenced by objectives and inner mechanisms that are difficult for external innovators to understand.

The analysis of how OIIs can be utilized to mitigate barriers to outbound public sector OI found four interrelated roles: expanding the boundaries of innovation ecosystems; decreasing costs for distant search and data processing; fostering inter-organizational collaboration; and assisting public organizations in managing the innovation trajectory. As such, this analysis expanded and refined descriptions of the roles of OIIs found in previous OI literature. Nonetheless, the studied cases also illustrated that innovation seekers and external innovators can contest the introduction of OIIs, and that they might have hampering effects as well. Hence, the analysis suggested that OIIs need to be carefully designed and launched so that they match the needs of the specific situations.

Needless to say, this thesis does not mark the end of the road for studies on public sector OI. To maximize naturalistic generalizability; that is, the transferability to other similar cases (cf. Stake 1978), the four case studies were purposively selected to minimize differences between them. The studied innovation seekers were confined to a specific sector (PT) and to a specific cultural context (Sweden). Thus, they operated under equal institutional conditions, dealt with similar external innovators and used comparable OI tactics for more or less the same reasons. Additional studies addressing barriers to public sector OI, and the roles of OIIs in mitigating them are needed in order to establish transferability of the findings (or lack thereof) to the entire population of public sector OI. In particular, this thesis calls for three types of complementary case studies: public sector OI in industry sectors and countries that have dissimilar traditions when it comes to public-private collaborations; public sector OI pursued by distinct types of public organizations (e.g. international institutions and municipalities); and public sector OI that follows coupled OI logics. Furthermore, to complement the studies on public sector OI and private sector OI, studies addressing OI initiated by civil sector organizations would add an interesting perspective.

Specifically for barriers to outbound public sector OI, this thesis highlights a need for a better understanding of how different types of innovation seekers perceive and handle barriers. It also emphasizes that it primarily is the perception of barriers and not the barriers per se that limits the adoption and outcome of outbound public sector OI. Thus, studies that attempt to compare the actual impacts of barriers with the corresponding perceptions would be welcomed. Specifically for the role of OIIs in public sector OI, this thesis exemplifies that extant descriptions of OIIs are quite vague (e.g. Abbate et al. 2015; Bakici et al. 2012; Hallerstedt 2013). Consequently, OIIs with very different agendas, set-ups and service offerings currently fit under the umbrella term, which makes it difficult for both practitioners and scholars to compare their roles (so also in this thesis). Hence, extant attempts to develop categorizations of OII types should be refined (Lopez-Vega and Vanhaverbeke 2009). Finally, studies that address less researched viewpoints on OIIs would enrich the understanding of their roles and impacts. This includes the perspectives of end-users of innovations (oftentimes citizens) and policy makers as well as internal managers (cf. Ollila and Elmquist 2011).

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